

CALIFORNIA  
AGRICULTURAL EXTENSION SERVICE

CIRCULAR 15

March, 1928

PORK PRODUCTION  
IN CALIFORNIA


E. H. HUGHES AND L. W. FELDMILLER

PUBLISHED BY  
THE COLLEGE OF AGRICULTURE  
UNIVERSITY OF CALIFORNIA

Coöperative Extension work in Agriculture and Home Economics, College of Agriculture, University of California, and United States Department of Agriculture coöperating. Distributed in furtherance of the Acts of Congress of May 8 and June 30, 1914. B. H. Crocheron, Director, California Agricultural Extension Service.

UNIVERSITY OF CALIFORNIA PRINTING OFFICE  
BERKELEY, CALIFORNIA

1928



Digitized by the Internet Archive  
in 2011 with funding from  
University of California, Davis Libraries

# PORK PRODUCTION IN CALIFORNIA

E. H. HUGHES<sup>1</sup> AND L. W. FELDMILLER<sup>2</sup>

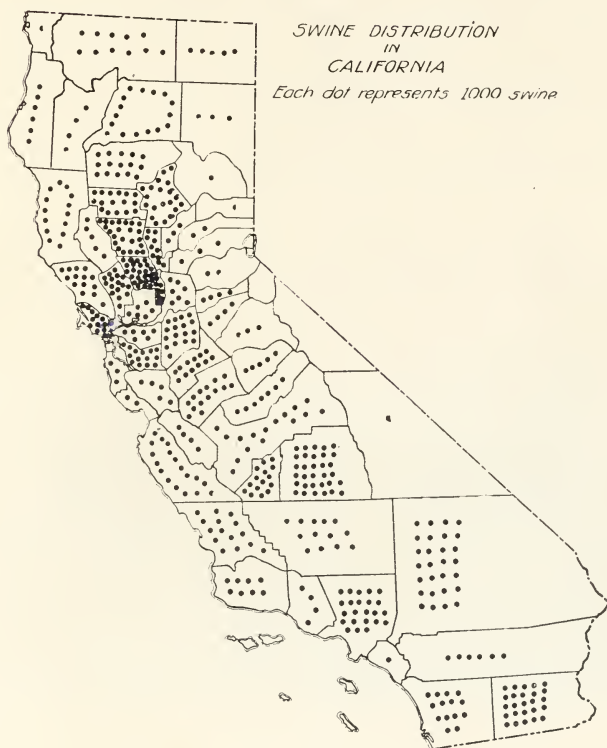


Fig. 1.—Outline map, showing production areas.

## INTRODUCTION

The demand for pork products in California exceeds the supply, and because of the rapidly increasing population it will probably continue to do so. For this reason live hogs bring one or two cents more a pound on the San Francisco, Oakland, and Los Angeles markets than on the mid-western markets.

In the Great Valley and the adjacent foothills, large crops of barley, grain sorghums, and alfalfa are raised annually. That these feeds will produce pork of excellent quality has long been known.

<sup>1</sup> Associate Professor of Animal Husbandry and Associate Animal Husbandman in the Experiment Station.

<sup>2</sup> Herdsman, Branch of the College of Agriculture, Davis, California.

Barley and rice stubble, surplus by-products from the packing plant and the dairy, damaged and cull fruits and vegetables, and kitchen waste can be utilized economically by the pig in the production of fresh and cured meats for the home and for the commercial trade.

Climatic conditions are excellent. Since green feed is always available during the winter months, it is possible to pasture all year. During the summer months, if there is no natural shade, artificial shade should be provided. A shelter sufficient to keep the pigs dry is advisable during the winter season.

Two litters a year are produced by most growers. The fall pigs often develop as well as the spring litters.



Fig. 2.—The finished product, bred and fed on a California farm.

Swine raising is logically an integral part of a diversified agriculture. A few pigs on most farms would increase the net returns. With few exceptions there is enough feed wasted on every farm to supply the pork consumed on that farm. Pork production may be carried on profitably with a small amount of capital invested in foundation stock, labor, and equipment.

#### LOCATION OF FARM AND EQUIPMENT

The ideal location of a hog ranch is one where alfalfa can be produced cheaply, where barley or other grain feeds can be grown economically, and where shade and water are plentiful. Pork production in conjunction with the dairy, where skim milk, buttermilk, or whey is available has long been recognized as good practice.

If the swine barn and lots can be located where natural shade is provided and where drainage is good or where the soil is light or sandy, it is much easier to keep the hogs cool during the summer and clean during the winter. Nearness to market, good shipping facilities, productive soil, adequate water supply, and natural shade are all factors which make for success in profitable pork production.

*Central or Farrowing House.*—Two types of central or farrowing houses are in use, one consisting of two rows of farrowing pens with an alley through the center and storage space at one end (fig. 3), and the other being simply a series of farrowing pens covered with a shed roof. In both types the partitions should be at least 30 inches



Fig. 3.—Central farrowing house in use at the University of California, with Sudan grass pasture in the foreground.

high and may be of wood, woven-wire, or gas-pipe construction. A door in each pen should lead to an outside pen where the sow and pigs may have access to the direct rays of the sun and where exercise will be taken naturally. The floor should be of concrete or board because it is practically impossible to keep a dirt floor clean and free from infection. The farrowing pen should be at least 6 feet wide and 8 feet long, with a guard rail about 8 inches above the floor to afford protection for the small pigs.

*Movable Houses.*—There are many types of movable houses. The most desirable for California conditions, however, is one that affords protection against rain in the winter and provides shade during the summer. Satisfactory dimensions are 8 feet wide by 14 feet long, with sides at least 3 feet high. A gable roof and a board floor are desirable (fig. 4). Built on 4 by 6-inch runners or skids, such a house may be moved from one lot to another.



*Fencing.*—Fences are an important part of the equipment. Wood, concrete, or steel posts are satisfactory. The posts should be not farther than 8 or 10 feet apart. Several types of fencing are in use. For small lots, a fence built of 1 by 6-inch unsurfaced boards, four boards high, with about a 3-inch space between the bottom boards is a very good one. Woven-wire fencing, however, is very popular. An excellent woven-wire fence has a diamond mesh, 32 inches in height, with a barbed wire at the bottom and at the top.

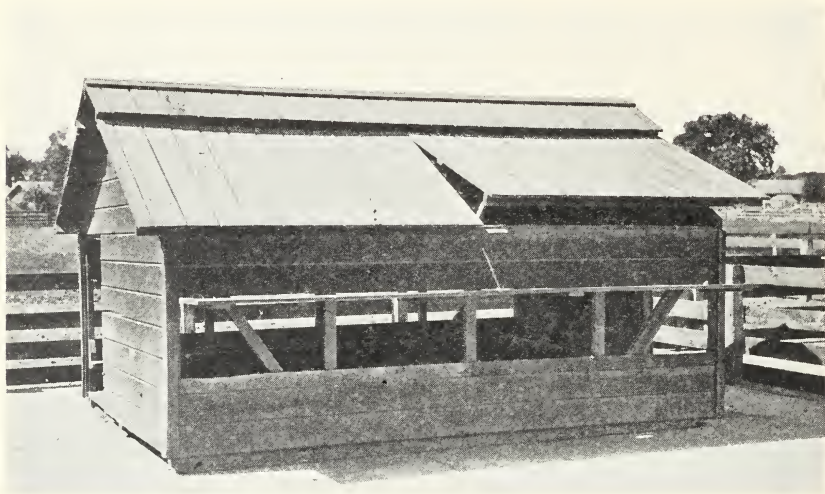


Fig. 4.—Movable house that affords protection in winter and shade during the summer months. A partition may be placed in the middle, affording farrowing quarters for two sows.

*Hog Wallows.*—Concrete hog wallows 8 or 10 feet wide and 14 to 16 feet long are desirable equipment. They should be so constructed as to be easily accessible and should be supplied with a drain to facilitate cleaning. Only 4 to 6 inches of water need be kept in the wallow, and this should be frequently removed and the wallow thoroughly cleaned. A film of crude or crank-case oil on the water is a valuable preventive of lice and mange, and aids in keeping the hair of the pig in good condition.

#### TYPES AND BREEDS

Both lard and bacon types of hogs are found in the state. Of the former, the most common are the Berkshire, Hampshire, Chester White, Duroc-Jersey, and Poland-China, the last two named being more numerous than the other breeds. Of the bacon type, the Tam-

worth is most common, although a few large Yorkshires are found, principally in the northern part of the state.

During recent years a gradual change in the lard type of hogs has been brought about by changing demands of the consuming public and by the realization of the producer that a longer-legged and more upstanding hog is grown more rapidly and is a better rustler than the wide, shorter-legged animal (figs. 5 and 6). This change in type has, perhaps, been partially responsible for an increase in the prolificacy of the average sow. Probably the added length and depth have given the brood sow more capacity, which, in turn, has resulted in an increase in milk production.

#### SELECTION OF THE BREEDING HERD

In selecting animals for breeding purposes, it is good practice to purchase from a reputable individual or firm.

There are three ways of determining the value of an animal as a breeder: first, by individuality; second, by pedigree; and third, by progeny. Most hogs selected for the production of pork are chosen on their individuality and pedigree. Animals two years old or over are seldom purchased for this purpose. Wherever possible, purebred animals should be used in founding a herd. A purebred sire should always be used. If it is not possible or feasible to begin with purebred sows, high-grade animals of good conformation and constitution may logically be substituted.

To select breeding animals requires an appreciation of the essential functions which the different classes of hogs have to perform. A finished barrow is one which has been a good feeder, which will dress out profitably as a killer, and which will meet the demand of the consumer.

*Selecting the Brood Sow.*—Uniformity of type, color markings, and similarity in bloodlines, should be considered when choosing the sow herd. It is advisable that each one be a prolific and regular breeder. For this reason, a knowledge of the prolificacy of the sire and dam is of value. It is often advantageous and as cheap to buy sows already bred to a good boar. One should keep in mind that the sow should produce pigs that will make good feeders, gain rapidly, be finished at a marketable weight, and be of a type that will produce maximum returns when slaughtered.

The good brood sow should be large, show femininity and refinement about the head, have large, clear eyes, ears medium in size, be

neat in the jawl, and have desirable width between the eyes and a strong muzzle. Her back and loin should be strong and slightly arched; she should be smooth about the shoulders, and have long, deep, smooth sides. Her hams should be deep, full, and not flabby. The udder should be well developed with from ten to fourteen teats. She should have straight, strong legs, not too close together, with bone of good quality, and short pasterns. Her chest should be deep and not pinched, showing a strong constitution. Fine hair, smoothness of outline, and refinement indicate quality.

The ideal brood sow will show indications of an even temperament. She should be docile, and not display an irritable disposition. The nervous, excitable sow does not raise as large a percentage of pigs farrowed as the one with an even temperament.

When the pigs are weaned, it is good practice to check up the records and to sort out for fattening those sows which, for some reason or another, did not raise large litters or which raised pigs of poor type and quality.

*Selecting the Boar.*—Inasmuch as a large part of the improvement in the herd comes through the use of a good sire, the selection of the boar is extremely important. The boar should be purebred. There is no excuse for the use of a grade or scrub boar. The boar should not be purchased when too young. The selection should be deferred until he is about six months of age, when any serious defects may be detected. It is practically impossible to foresee at weaning time the pig's development. He should be from a prolific family to insure in his offspring the ability to produce large litters.

The temperament of the boar is as important as that of the sow. A cross, irritable boar is hard to handle and should not be selected unless he has some extraordinary qualities needed in the herd.

The boar should be large and rugged, showing masculinity and strength. Masculinity is shown in a strong muzzle, large, clear eyes, ears that are somewhat larger than those of the sow, a strong neck, and well developed shoulders. He should possess straight, strong legs, with plenty of bone. The pasterns should be short and straight. The body of the boar should be thicker than that of the sow, with more width of back; the back and loin should be strong and slightly arched; the sides, deep and smooth, with full hams.

The boar does not show quite so much refinement as the sow; however, coarseness, especially wrinkles and creases about the shoulder, are objectionable. The sex organs should be well developed.





Fig. 5.—A contrast in types. This excellent sow, in proper breeding condition, was nine years old in February and is still a producer. She has already farrowed 142 pigs.



Fig. 6.—An old type of brood sow, too heavy in the shoulder and jowl, lacking in udder development, and too fat for best results.

*Selecting the Young Boar or Gilt.*—If it is necessary to purchase a young boar or gilt, care should be taken not to select one that seems too mature for its age. Choose rather the boar or gilt that has straight, strong legs and back, with plenty of length, is slightly upstanding, showing smoothness and quality throughout.

## FEEDS

While the pig requires less dry matter for a pound of gain than a cow or sheep, the capacity of the stomach and the intestinal tract is such that he is able to make small use of fiber. A greater amount of concentrates and a relatively smaller amount of roughages are required in producing pork than in producing beef or mutton. The fact that concentrates, particularly the cereal grains, carry relatively small amounts of calcium probably accounts for the prevalence of rickets in swine-producing sections.

Hogs are kept to market raw materials to advantage. The purchase of feeds is usually confined to supplementing such common home-grown feeds as barley, the grain sorghums, corn, rice stubble, and cull fruits. A discussion of feed stuffs is given to enable the producer to determine the materials that should be provided that a maximum profit be obtained. Hog feeds may be divided into four classes:

First, carbonaceous concentrates, which are primarily the cereal grains and other feeds containing large quantities of starches and sugars and relatively small quantities of protein. The starches and sugars produce energy, which is either used up from day to day in the ordinary metabolism processes, or stored in the animal body in the form of fat.

Second, nitrogenous concentrates, or proteins, which are growth-producing elements and are found in large quantities in by-products of the dairy and packing houses, in linseed-oil meal, and in certain forages and hays, particularly the legumes.

Third, forages and hays, particularly from the legume plants, which provide variety in the ration and also contain minerals, proteins, and vitamins.

Fourth, minerals or mineral mixtures which seem necessary for the proper growth and development of the skeleton, where the normal ration fails to provide enough calcium, phosphorus, sodium, and magnesium.

## PREPARATION OF FEEDS

Cooking either grains or forage does not increase the digestibility or value, but probably decreases the digestibility of the proteins. Experiments conducted at this and other stations show that cooking corn, barley, wheat, oats, and the grain sorghums decreases their value about 10 per cent.

It pays to grind, roll, or crush barley, wheat, and the grain sorghums. If such grains cannot be ground or rolled, it is advisable to feed them soaked.

## CARBONACEOUS CONCENTRATES

*Barley.*—Barley, which is more widely used as a hog feed in this state than any other cereal, contains more protein and requires a smaller amount of protein supplements than corn. Like corn, its proteins are unbalanced in composition. It is also low in calcium content. Pigs fed barley or barley and wheat middlings in dry lot need additional protein, either of an animal origin or from some such legume as green alfalfa or alfalfa hay.

Barley contains somewhat less total digestible nutrients than corn and is also higher in fiber content, thus being somewhat less valuable pound for pound than corn. Bacon and hams produced from barley, however, are of prime quality. Barley is the principal feed used in Europe and in Canada for the production of the bacon which has such an excellent reputation on the English market.

Henry and Morrison<sup>3</sup> report the average results of eight trials at northern experiment stations with pigs weighing an average of 109 pounds. Hogs fed barley and tankage gained 1.44 pounds per head daily, while those fed corn and tankage gained 1.64 pounds. The former consumed 439 pounds of barley and 30 pounds of tankage for 100 pounds of gain. They required 50 pounds more grain and 9 pounds less tankage for 100 pounds of gain than the hogs fed corn. Both groups were self-fed.

At the California Agricultural Experiment Station,<sup>4</sup> the average of five trials with pigs weighing from 60 to 120 pounds shows a gain of 1.54 pounds daily; the average feed consumed for 100 pounds of gain was 420 pounds of barley and 42 pounds of tankage.

<sup>3</sup> Henry, W. A., and F. B. Morrison. Feeds and feeding, a handbook for the student and stockman. p. 632. The Henry-Morrison Co., Madison, Wis. 1923.

<sup>4</sup> Hughes, E. H. Rice and rice by-products as feeds for fattening swine. California Agr. Exp. Sta. Bul. 420:1-24. 1927.



TABLE 1  
DIGESTIBLE NUTRIENTS IN CARBONACEOUS CONCENTRATES\*

Feed	Total dry matter in 100 pounds	Digestible nutrients in 100 pounds				Nutritive ratio	Ash in 100 pounds
		Crude protein	Carbo-hydrates	Fat	Total		
	<i>pounds</i>	<i>pounds</i>	<i>pounds</i>	<i>pounds</i>	<i>pounds</i>		<i>pounds</i>
Barley.....	90.7	9.0	66.8	1.6	79.4	1: 7.8	2.7
Corn.....	89.5	7.5	67.8	4.6	85.7	1:10.4	1.5
Wheat.....	89.8	9.2	67.5	1.5	80.1	1: 7.7	1.9
Oats.....	90.8	9.7	52.1	3.8	70.4	1: 6.3	3.5
Rye.....	90.6	9.9	68.4	1.2	81.0	1: 7.2	2.0
Kafir.....	88.2	9.0	65.8	2.3	80.0	1: 7.9	1.7
Milo.....	89.3	8.7	66.2	2.2	79.9	1: 8.2	2.8
Sorghum.....	87.3	7.5	66.2	2.6	79.5	1: 9.6	1.9
Feterita.....	88.9	10.1	65.4	2.4	80.9	1: 7.0	1.5
Kaoliang.....	90.1	8.5	67.0	3.3	82.9	1: 8.8	1.9
Rice (rough).....	90.4	4.7	64.6	1.7	73.1	1:14.6	4.9
Rice bran.....	89.9	7.9	38.1	8.8	65.8	1: 7.3	9.7
Rice polish.....	90.0	8.0	47.2	7.5	82.1	1: 9.3	4.8
Molasses (cane or blackstrap).....	74.3	1.0	58.5		59.5	1:58.5	6.1
Raisins.....	87.0	2.8	70.0	1.0	73.8	1:25.8	2.2
Artichokes.....	20.7	1.0	14.6	0.1	15.8	1:14.8	1.7
Beets (common).....	13.0	0.9	9.1	0.1	10.2	1:10.3	1.5
Potato.....	21.2	1.1	15.8	0.1	17.1	1:14.5	1.1
Sweet potato.....	31.2	0.9	24.2	0.3	25.8	1:27.7	1.1
Pumpkin.....	8.3	1.1	4.5	0.5	6.7	1: 5.1	0.9

*Corn.*—Corn is the most important pork-producing crop in the United States. In total digestible nutrients, it exceeds all other important carbonaceous feeds. Because of its relatively low content of proteins and its high percentage of carbohydrates and fats, it is better for fattening than for producing growth. Corn supplemented with skim milk, buttermilk, tankage, or fish meal, however, produces rapid and economical gains. Yellow corn, when fed alone, has been found to be superior to white corn.

*Wheat.*—Wheat, when ground and fed alone or with protein supplements, produces more rapid and economical gains than does corn, although because of its value for human consumption, very little is available for livestock feeding.

\* Henry, W. A., and F. B. Morrison. Feeds and feeding, a handbook for the student and stockman. Appendix tables I and III, pp. 709-743. The Henry-Morrison Co., Madison, Wis. 1923.

*Oats.*—Oats, when fed in conjunction with barley and other feeds, are an excellent concentrate for brood sows, boars, and young gilts which are to be retained in the breeding herd. The high fiber content and the relatively low percentage of total digestible nutrients are factors which prevent the universal use of oats in fattening young pigs.

*Rye.*—While rye contains as high a percentage of total digestible nutrients as barley, its limited production accounts for its restricted use for pork production in the state.

*The Grain Sorghums.*—The grain sorghums, particularly kafir and milo, are very popular swine feeds in the southwestern states, as well as in California. The total digestible nutrients are about equal in all of the grain sorghums and the ratio between the protein content and the carbohydrates and fats varies only slightly. Because of their extreme hardness, these feeds, like barley, should be ground or rolled. The proteins in them, as in barley and corn, are unbalanced, a factor which necessitates the feeding of some animal protein when the young growing pigs, fattening pigs, or brood sows have no access to alfalfa or other legume pasture. These grain sorghums are also low in calcium.

Kafir and milo are considered by producers in the southwestern states to have a value slightly lower than that of corn for growing and fattening pigs. Thompson and Voorhies<sup>5</sup> found ground milo to be less efficient in fattening pigs in the dry lot than barley when supplemented with tankage in self-feeders.

*Rice (Rough or Paddy).*—Rough or paddy rice does not make a satisfactory hog feed when fed whole or cooked in dry lot, even when supplemented with a nitrogenous supplement like tankage. It has been found satisfactory, however, when ground fine and self-fed with tankage. With this preparation it compares favorably with barley in daily gain and amount required for 100 pounds of gain. Hogs weighing 100 pounds or more do well in rice stubble.

*Rice Bran.*—This by-product of the rice-milling industry should not be fed alone to young growing or fattening pigs. Although the total digestible nutrients are somewhat lower than those of barley, it is a desirable feed when fed with a protein supplement and barley or corn. There are two defects in this feed: first, the amount of fiber is relatively higher than in most concentrates; and second, it contains certain unsaturated fatty acids which, if fed alone over a long period

<sup>5</sup> Thompson, J. I., and Edwin C. Voorhies. Hog feeding experiments. California Agr. Exp. Sta. Bul. 342:373-396, 1922.



of time, will produce soft or oily pork. If it constitutes not more than 40 per cent of the ration, the pork produced is not soft. Pigs self-fed rice bran and tankage in dry lot will consume about twice as much tankage for 100 pounds of gain as when fed a ration of barley and tankage.

*Rice Polish.*—Rice polish, like rice bran, is a by-product of the rice-milling industry. It is a more efficient feed than rice bran and has not the same tendency to produce soft pork. Because its fiber content is very low, it contains more total digestible nutrients than barley. This feed should always be fed with a protein supplement and some other carbonaceous feed because of the laxative effect it produces. Two lots of pigs at this station,<sup>6</sup> self-fed rice polish and tankage, gained as rapidly as did the check lots fed rolled barley and tankage. For 100 pounds of gain they consumed 121.17 pounds less rice polish and 12.34 pounds more tankage than did the barley lots.

*Molasses.*—When molasses is cheaper than barley, this feed may be substituted for a part of the grain ration. Molasses is used less frequently in feeding swine than other classes of livestock.

*Raisins.*—Low-grade and cull raisins are sometimes available for swine feeding. Raisins are a carbonaceous feed, as is shown by the fact that the sugar content usually exceeds 60 per cent. At the California station<sup>7</sup> it has been found that raisins are a desirable feed for growing and fattening swine when fed in conjunction with barley and some protein supplement. Pigs fed raisins alone or with a protein supplement in dry lot or on pasture often scour severely. Pound for pound, they are not so valuable as barley for fattening pigs.

*Tubers and Vegetables.*—Such products as artichokes, beets, potatoes, sweet potatoes, and pumpkins are relished by hogs and supply a certain amount of nutrients and variety when fed in conjunction with other feeds. The small amount of total digestible nutrients and the large amount of water in such feeds suggest their limitations.

#### NITROGENOUS CONCENTRATES, OR PROTEIN SUPPLEMENTS

*Dairy By-Products.*—Skim milk and buttermilk are the most valuable supplements that may be used to balance the protein deficiencies in the cereal grains. The amino acids which are necessary for growth and which are found in these protein feeds are not usually

<sup>6</sup> Hughes, E. H. Rice and rice by-products as feeds for fattening swine. California Agr. Exp. Sta. Bul. 420:1-24. 1927.

<sup>7</sup> Hughes, E. H. The feeding value of raisins and dairy by-products for growing and fattening swine. California Agr. Exp. Sta. Bul. 440:1-12. 1927.

found in large quantities in the grains. Calcium and phosphorus, which are necessary for the development of the skeleton and which help balance the lime deficiency of the carbonaceous part of the ration, are also found in skim milk and buttermilk. These supplements are excellent feeds for the brood sow, because proteins, phosphorus, and lime are very necessary for the development of the fetus during the gestation period and for the production of milk for the growing litter during lactation. Skim milk and buttermilk should always be pasteurized before being fed to swine, in order that tuberculosis and other diseases may not be contracted from this source.

Skim milk, buttermilk, or whey may be fed separately or with barley or a mixture of grain feeds in the form of a slop. The ratio of 1 pound of rolled barley to 3 pounds of one of these by-products gives excellent results and provides a slop of about the right consistency.

TABLE 2  
DIGESTIBLE NUTRIENTS IN PROTEIN SUPPLEMENTS\*

Feed	Total dry matter in 100 pounds	Digestible nutrients in 100 pounds				Nutritive ratio	Ash in 100 pounds
		Crude protein	Carbo-hydrates	Fat	Total		
	pounds	pounds	pounds	pounds	pounds		pounds
Skim milk.....	9.9	3.6	5.1	0.2	9.1	1:1.5	0.7
Buttermilk.....	9.4	3.4	4.9	0.1	8.4	1:1.5	0.7
Dried skim milk.....	95.5	32.5	49.9	1.9	86.7	1:1.7	25.1
Dried buttermilk.....	88.3	29.3	41.0	6.2	84.2	1:1.9	8.1
Whey.....	6.6	0.8	4.7	0.3	6.2	1:6.8	0.7
Tankage.....	92.1	56.2	.....	7.2	71.4	1:0.3	15.3
Fish meal.....	89.5	40.1	.....	8.3	58.8	1:0.5	28.1
Wheat bran.....	89.9	12.5	41.6	3.0	60.9	1:3.9	6.3
Wheat middlings.....	89.5	13.4	46.2	4.3	69.3	1:4.2	4.4
Linseed oil meal (old process).. <td>90.9</td> <td>30.2</td> <td>32.6</td> <td>6.7</td> <td>77.9</td> <td>1:1.6</td> <td>5.4</td>	90.9	30.2	32.6	6.7	77.9	1:1.6	5.4
Cottonseed meal (good).....	92.1	31.6	25.6	7.8	74.8	1:1.4	6.4
Coconut meal (new process).....	90.0	19.9	44.2	3.0	70.8	1:2.6	6.0
Beans, navy.....	86.6	18.8	51.3	0.8	71.9	1:2.8	3.6
Pea, field.....	90.8	19.0	55.8	0.6	76.2	1:3.0	3.4
Cow pea seed.....	88.4	19.4	54.5	1.1	76.4	1:2.9	3.4
Soybean meal.....	90.1	33.2	24.7	16.1	94.1	1:1.8	5.3
Alfalfa hay.....	91.4	10.6	39.0	0.9	51.6	1:3.9	8.6
Alfalfa meal.....	91.2	10.2	38.7	0.8	50.7	1:4.0	9.0
Alfalfa leaves.....	93.4	17.3	35.9	3.0	60.0	1:2.5	13.6
Green alfalfa.....	25.3	3.3	10.4	0.4	14.6	1:3.4	2.4
Green rape.....	16.7	2.6	10.0	0.3	13.3	1:4.1	2.2

\* Henry, W. A., and F. B. Morrison. Feeds and feeding, a handbook for the student and stockman. Appendix tables I and III, pp. 709-743. The Henry-Morrison Co., Madison, Wis. 1923.

Tankage fed with barley is the most satisfactory substitute for skim milk. Thompson and Voorhies,<sup>8</sup> reporting an average of two trials, found that pigs fed barley and skim milk made an average daily gain of 1.56 pounds per head, consuming 455 pounds of barley and 666 pounds of skim milk for each 100 pounds of gain; that those fed barley and tankage made an average daily gain of 1.43 pounds, consuming 498 pounds of barley and 19 pounds of tankage for each 100 pounds of gain.

Hughes<sup>9</sup> fed two lots of pigs in dry lot, the average initial weight of the first group being 54.33 pounds, and of the second group 77.10 pounds. An average daily gain of 1.73 pounds was obtained for both groups; and for every 100 pounds of gain, 281.31 pounds of barley, 712.18 pounds of skim milk, and 3.92 pounds of tankage were required.

Buttermilk which has not been diluted has about the same chemical composition and total digestible nutrients as skim milk, and while the results of one trial at California indicate it to be slightly inferior to skim milk when fed with barley, those reported by Wilson at the South Dakota station<sup>10</sup> show it to have an equal value when fed with corn.

Concerning dried skim milk and buttermilk, there is not much available information. They contain about one-half as much protein as does tankage, and the price is relatively higher. Feeding tests are being conducted at this station to obtain information on these feeds.

Whey contains about 6.2 pounds of total digestible nutrients in 100 pounds. Of this amount, only 0.8 pound is protein, the remainder having been removed in the form of casein during the cheese-making process. Because of the low protein content, whey was formerly thought to have little value as a supplement to the grains. A feeding trial at this station, however, showed that although more whey and grain are required for 100 pounds of gain than when skim milk was fed, and the daily gain was somewhat less, it is of considerable value.

Surprising results were obtained by Morrison and Russell<sup>11</sup> at the Wisconsin station when two lots of pigs self-fed barley and all the whey they would consume gained 2.22 pounds per head daily.

---

<sup>8</sup> Thompson, J. I., and Edwin C. Voorhies. Hog feeding experiments. California Agr. Exp. Sta. Bul. 342:373-396. 1922.

<sup>9</sup> Hughes, E. H., The feeding value of raisins and dairy by-products for growing and fattening swine. California Agr. Exp. Sta. Bul. 440:1-12. 1927.

<sup>10</sup> Wilson, James W. Fattening pigs. South Dakota Agr. Exp. Sta. Bul. 319:70-71. 1912.

<sup>11</sup> Morrison, F. B., and H. L. Russell. Experiments in farming. Wisconsin Agr. Exp. Sta. Bul. 319:70-71. 1920; also New farm facts. Wisconsin Agr. Exp. Sta. Bul. 323:8-10. 1920.

They required 353 pounds of barley and 854 pounds of whey for 100 pounds of gain. The pigs used in these trials were well grown and weighed from 125 to 150 pounds when placed on feed. It is hard to explain these results because of the low protein content of whey. The protein must be of excellent quality.

*Tankage.*—Tankage, or meat meal, is a by-product of the packing house, extremely rich in digestible protein. Calcium and phosphorus are present in appreciable amounts. The proteins of this feed combine well with those of the cereal grains to produce rapid growth. This product is being fed by pork producers in all sections of the United States. Being cooked under high pressure and thoroughly dried, it is a safe feed to use. Excepting the by-products of the dairy, no other protein feed has met with such favor among hog producers. Because of its high protein content, it takes a relatively small amount of this feed to balance a corn or barley ration for the growing or fattening pig, the boar, or the brood sow. A ration of ten parts of barley or corn to one part of tankage, by weight, has become a standard ration for hogs in dry lot. Where alfalfa or other green pasture is available, the amount of tankage can be reduced. Very young pigs will do better if such a feed as wheat middlings or linseed-oil meal is added to a barley and tankage ration. A standard 60 per cent protein tankage is recommended.

The results of several experiments at the California station show that a ration of rolled barley and tankage self-fed in dry lot produced gains of 1.54 pounds per head daily on pigs weighing 60 to 120 pounds and that 420 pounds of rolled barley and 42 pounds of tankage were required for 100 pounds of gain. Excellent results are usually obtained by feeding barley and tankage in separate self-feeders; however, these feeds can be mixed and then placed in the feeder. For young pigs, a mixture of rolled barley, wheat middlings, and tankage put in a self-feeder produces excellent results, especially if a little skim milk is fed in addition.

*Fish Meal.*—While this product contains less digestible protein than tankage and has less total digestible nutrients, surprisingly good results have been obtained from its use. It contains more than 25 per cent ash or mineral matter, much of which is calcium and phosphorus. Henry and Morrison<sup>12</sup> report in a summary of experiments conducted in various experiment stations, that pigs fed a carbonaceous concentrate with fish meal gained more rapidly and required slightly less feed

<sup>12</sup> Henry, W. A., and F. B. Morrison. Feeds and feeding, a handbook for the student and stockman. p. 653. The Henry-Morrison Co., Madison, Wis. 1923.



for their gains than did pigs fed a carbonaceous concentrate and tankage. Thompson and Voorhies,<sup>13</sup> on the other hand, found that barley and tankage were superior to barley and fish meal.

*Wheat Bran.*—Wheat bran is an excellent addition to the ration of a brood sow, both before and after farrowing. It is a bulky, slightly laxative feed. Because of its bulky nature, it is not a good feed for fattening pigs.

*Wheat Middlings.*—Wheat middlings or shorts is a very popular feed among pork producers. Although the protein content is not high and the proteins do not balance those of the cereals, a mixture of wheat middlings, rolled barley, and either skim milk or tankage produces excellent results if fed to the young growing pigs before and, particularly, after weaning.

*Linseed-Oil Meal.*—Linseed-oil meal is not used so extensively in this state as in other sections of the country. Because the proteins in this feed are similar to those of barley and other grains, the feeder should not expect maximum results by feeding barley and linseed-oil meal alone. A ration of barley, linseed-oil meal, and tankage or skim milk, however, will give excellent returns. This feed is used extensively by purebred hog men fitting hogs for the shows.

*Coconut Meal.*—Coconut meal, when not rancid, can be fed with barley in the proportion of one part to three or four parts of barley, by weight, on alfalfa pasturage. Coconut meal and barley should not be fed in dry lot without the addition of some animal protein such as skim milk, tankage, or fish meal.

*Cottonseed Meal.*—As cottonseed meal is poisonous to swine, its use as a swine feed is not recommended. It contains about half as much protein as tankage does.

*Beans.*—Navy beans should always be cooked and fed with barley or corn. Salt added to the water when cooking adds palatability to this mixture. Pigs fed beans alone produce soft, watery carcasses.

*Field Peas.*—Peas are not commonly thrashed and fed to hogs; however, in some sections, particularly in the northern and northwestern states, they are grown and then hogged down. Where field peas can be grown successfully, they make, with oats or barley, an excellent crop for hogging-down purposes.

*Cow Peas and Soy-Bean Meal.*—Though these feeds are not grown extensively in this state, soy beans are being fed in large quantities in some corn-belt areas. Soy-bean meal has a high protein and fat

<sup>13</sup> Thompson, J. I., and Edwin C. Voorhies. Hog feeding experiments. California Agr. Exp. Sta. Bul. 342:373-396. 1922.



content. Pigs do well when fed this meal with barley or corn and some animal protein, such as tankage. Soy-bean meal, like peanut meal or rice bran, when fed in too large quantities, produces soft pork.

*Alfalfa Hay, Alfalfa Meal, and Alfalfa Leaves.*—While these feeds are too bulky to feed young growing pigs in large quantities, they carry an excellent variety of proteins and are high in lime and fat-soluble vitamins. When mixed with barley or barley and some supplement, 5 or 10 per cent by weight is sufficient alfalfa to include. The addition of alfalfa hay (chopped) or alfalfa meal to a ration of barley and some plant protein supplement, such as wheat middlings or linseed-oil meal, gives excellent results because of the character of proteins in alfalfa and the ash that it contains.

During the wet winter months when brood sows cannot be pastured on alfalfa, alfalfa hay should constitute a regular part of their rations.

#### FORAGE CROPS

Forage crops are recognized as a necessary adjunct to any well-organized pork-producing plant. Brood sows, boars, and growing and fattening pigs, when pastured on alfalfa or other forage, exercise naturally, receive the direct rays of the sun, and are more healthy than those kept in small, cramped quarters. Experiments have shown that pigs fed on forage crops gain more rapidly and that the tonic effects of the succulence, the laxative properties of the green feed, and the variety of proteins, the vitamins, and the minerals supplied are responsible for the thrift, health, and growth of pigs produced in this manner.

When grains are high in price or are not available, pigs can be maintained and grown with a minimum amount of concentrates if forage crops are used. The latter, especially the legumes, reduce the amount of commercial protein supplements necessary to balance the ration and reduce the feed necessary to produce 100 pounds of gain in growing or fattening pigs.

*Alfalfa.*—Alfalfa pasture is recognized as the best forage crop for pigs because it may be grazed for a long period of time and is palatable, its proteins balance those of grains fed, and it has a high calcium content. This crop also produces a larger tonnage per acre than any other common forage. During the few short periods in the winter when the ground is too soft for pasture, the brood sows and pigs should be removed to dry lot and good, clean, leafy alfalfa hay substituted for the forage.

Excellent gains can be secured by feeding a ration of fifteen parts rolled barley and one part tankage, by weight, to pigs weighing from 50 to 200 pounds, on alfalfa pasturage. No forage has been found to equal alfalfa for brood sows, during either the gestation or the lactation period.

*Barley and Rape.*—Where alfalfa pasture is not available, a mixture of barley and rape may be substituted satisfactorily. If sown in September or October, this forage provides an excellent winter pasture during the time when alfalfa does not grow rapidly. For early spring pasture it can be sown either in January or February. The barley should be sown at the rate of about fifty pounds to the acre and the rape (Dwarf Essex) at about eight pounds. They can be either drilled or sown broadcast. For the best results this crop should be 8 or 12 inches in height before pigs or brood sows are turned in on it (fig. 7).

*Sudan Grass.*—Sudan grass sown at the rate of from eighteen to twenty pounds to the acre about the first of May, when the soil has become warm, is becoming popular as a summer pasture. Sudan yields a heavy tonnage if a good stand is secured. It does not provide so great a variety of proteins nor so large an amount of calcium or phosphorus as alfalfa pasture.

*Barley, Field Peas, and Vetch.*—A mixture of barley, field peas, and vetch has been reported by some producers in this state to be bringing excellent results. Such a mixture provides carbohydrates and a variety of proteins and minerals, but will not stand severe pasturing.

#### MINERALS

During the domestication of the pig, the development of breeds, and the improvement of swine, the producer has selected a type of hog that grows more rapidly and develops early. The value of a balance between the carbohydrates, fats, and proteins necessary for growth was found long before a knowledge of the requirements of minerals in the diet was obtained. The prevalence of stiffness and posterior paralysis (rickets) has brought about an effort among experiment station workers in animal husbandry to obtain information and to understand more clearly the various mineral requirements necessary for the proper development of the skeleton.

The common grains fed to hogs are deficient in calcium or lime, and the nitrogenous supplements necessary to balance the deficiency of protein in such feeds, unless they be dairy by-products, tankage,

fish meal, or alfalfa, do not provide *enough* calcium for the proper development of the skeleton. Even though the animal feeds mentioned—dairy by-products, tankage, fish meal—be fed, alfalfa pasture should also be provided to avoid a possible lime deficiency.

Experiments have shown that the feeding of a straight grain ration or a grain ration supplemented with such a protein feed as linseed-oil meal during the gestation period results in small, weak pigs at birth. This condition is brought about by a calcium and a protein deficiency in the ration, which results in an improper development of the fetus. A continued deficiency in the diet of the brood sow,



Fig. 7.—Young gilts, weighing about 75 pounds, on barley and rape forage; some concentrates were fed in addition.

if two litters are produced annually, usually results in sterility or posterior paralysis. The addition of alfalfa hay to such a ration has been found to be very beneficial. Young pigs fed a straight grain ration without access to alfalfa pasture or mineral mixture grow very slowly, become nervous, stiffened in their legs, and finally break down with severe rickets. Hughes<sup>14</sup> at this station, by feeding rolled barley (all the pigs would consume) or rolled barley and salt, produced rickets, both in the presence and in the absence of direct sunlight. However, those fed in the absence of sunlight always developed symptoms of rickets before those that had access to direct sunlight. Sunlight probably has a beneficial effect on calcium metabolism.

Mineral mixtures, where rations deficient in calcium or calcium and phosphorus are being fed, can be mixed with the feed or fed

<sup>14</sup> Unpublished data.

separately in small boxes in the lots, to which the brood sows and pigs have free access. The addition of one-half pound of air-slacked lime or finely ground limestone to 100 pounds of concentrate feeds will be found beneficial to practically all rations fed to swine in this state. While complex mineral mixtures are not recommended, a mixture of common salt, air-slacked lime (not quicklime) and finely ground bone meal, equal parts, has been used very successfully at the University Farm, for brood sows, boars, and growing and fattening pigs. Other mixtures, such as equal parts of air-slacked lime or ground limestone and salt, or equal parts of wood ashes and salt, may be used.

Recent investigations have shown that common salt adds to the palatability of the ration and that its presence stimulates the digestive glands. The addition of 1 per cent of salt to the grain ration has become a universal recommendation. Cereal grains supplemented with a protein rich feed supply enough phosphorus for normal growth and development. Both the grains (especially barley, corn, and the sorghums) and the supplements contain phosphorus.

## FEEDING AND MANAGEMENT OF THE BREEDING HERD

### THE BOAR

The boar holds a very important and prominent position in the breeding herd. Care should be exercised in his feeding and management, particularly during the breeding season. At this time he should be fed a ration that will maintain his condition during a season of heavy service. Such a ration must be well supplied with energy and carry a high protein and mineral content. Rolled barley or rolled barley and wheat middlings, equal parts, with the addition of 10 per cent of tankage by weight, mixed with enough skim milk to form a thick slop will meet his requirements.

A mineral mixture should be self-fed or added to the ration at the rate of 2 per cent. The boar should have access to some pasture, preferably alfalfa, if possible. If not, a little alfalfa hay is a good substitute. The amount to feed will depend on his condition and on the intensity of the breeding season. If working to full capacity, all the feed he will clean up twice daily is not too much.

After the breeding season is over, his daily ration can be reduced in quantity and slowly changed to one containing more carbohydrates and less protein. If, during the season of heavy service, he has lost weight, the ration should not be reduced until medium condition has been regained.



The boar lot is usually located apart from the rest of the herd. A quiet place, accessible to forage, and of a size large enough to insure sufficient exercise is desirable. Clean, dry, well-ventilated quarters, with shade in summer, are necessary.

Boars often become nervous, restless, and irritable and refuse to eat. This condition may be overcome in most instances by placing a barrow or bred sow with him for company.

Two methods of breeding may be followed, one known as hand mating, the other as promiscuous mating, where the boar is allowed to run with the sows. The system of hand mating is preferable. When such a system is followed, a mature boar in vigorous condition can be mated to about thirty sows during the active breeding season. The breeding of one sow a day is a most desirable practice, but a boar may be mated to two sows a day with satisfactory results, if one is bred in the morning and the other at night, provided he has a day of rest occasionally.

The sow, when in heat, may be brought to the boar or the boar may be driven to the sow's pen. Only one service should be permitted, as this is enough to insure pregnancy if the sow and boar are normal. After being bred, it is good practice to separate her from the open sows. Her number should be taken and a record of the time of mating made on the breeding record.

Where it is necessary to breed large sows to young boars or young gilts to mature boars, the use of a breeding crate may be found advantageous.

The feeding and management of the young boar is similar to that of the mature animal. A growing ration containing a high protein content, with plenty of calcium and phosphorus, is essential for maximum growth. Rolled barley, or rolled barley and wheat middlings, supplemented with skim milk, buttermilk, tankage, or fish meal, provides energy and growth-forming elements. Access to alfalfa forage, where exercise is taken naturally, and free access to a mineral mixture should provide the young growing boar with all the essential nutrients. The lot where the young boar or boars are kept should be away from the sow herd, particularly during the breeding season. The young boar at eight or nine months of age may be used on a limited number of sows without checking his growth. A day or two of rest between services is advisable.



## THE BROOD SOW

Under California conditions, with proper management, the sow should produce two litters a year, one in the spring and one in the fall. It is advisable to have spring litters farrowed on or after March 1. However, pigs farrowed during February do very well in most sections of the state, provided weather conditions are normal. Sows should not be bred to farrow much later than May 1, as the hot weather and flies often retard the normal growth of young pigs. Fall litters should be farrowed on or after September 1. It is undesirable to have sows farrow during the winter months, for the mortality due to cold, wet weather is high in very young pigs. Moreover, it is difficult to keep small suckling pigs in a thrifty, vigorous condition during the winter.

Breeding for spring litters should start about November 10, and for fall litters about May 10.

*Age to Breed.*—The age to breed a gilt depends to a great extent upon the development of the individual rather than upon the age. A stage of growth should be reached where the demands of the developing litter and subsequent suckling period will not materially affect her own development. In general, the practice of breeding gilts to farrow at twelve months is satisfactory. When size is desired in the mature sow, the gilt is allowed to rest one season after she farrows her first litter. Another method practiced to secure size is to breed gilts to farrow at the age of eighteen months. By this system, a gilt has practically reached her maximum growth and development when she farrows her first litter, and should produce regularly every six months thereafter.

As a general rule, gilts farrow fewer and smaller pigs than mature sows. The Illinois station<sup>15</sup> reported 7.5 pigs averaging 2.44 pounds as the average litter farrowed by gilts from one to one and one-half years old. Sows two years of age or older farrowed an average of 8.6 pigs weighing 2.61 pounds.

Since mature sows farrow larger litters and have larger pigs at birth than do gilts, it is poor policy to put too much dependence on gilts for the pig crop.

Sows at the California station during a period of six years farrowed 280 litters averaging 8.38 pigs farrowed and 6.37 pigs raised.

---

<sup>15</sup> Carmichael, W. J., and John B. Rice. Variations in farrow; with special reference to the birth weight of pigs. Illinois Agr. Exp. Sta. Bul. 226:67-95. 1920.

*Breeding Season.*—The condition of the sow at the time of service is largely responsible for the size of the litter and vigor of the pigs at birth. A sow that is excessively fat or very thin may not come in heat. If the boar is accepted under these conditions, very often the litters will be small or she may even fail to conceive.

At breeding time she should be in active breeding condition; that is, in medium flesh, and gaining from one-half to one pound daily. Best results will be obtained if the sows are on good pasture, preferably alfalfa, with enough concentrates to give the desired gain. A ration of rolled barley and tankage fed at the rate of 12 pounds of barley to 1 pound of tankage, with a suitable mineral mixture, will furnish the necessary nutrients.



Fig. 8.—Purebred brood sows taking advantage of clean young alfalfa pasturage.

Sows usually come in heat three to five days after weaning the pigs. The period of heat lasts about three days and occurs every twenty to twenty-one days in open sows. It is only during this period of heat that the normal sow will accept the boar.

The gestation period varies from 112 to 116 days, with 114 as the average. By keeping an accurate breeding record, the farrowing date may be calculated easily. This record is of considerable importance from the standpoint of the care of the sow during the week before farrowing.

*Feeding the Pregnant Sows.*—Sows on good pasture (fig. 8) in the summer months with an ample supply of fresh, clean water, and shade, will need but little grain during the first seventy-five days of the gestation period. A liberal grain ration should be fed during the

last month of pregnancy, as 75 per cent of the development of the fetus takes place during this period. Since the developing litter consists largely of protein and ash, a liberal supply of these materials in the ration will satisfy the demands of the developing fetus. If the necessary nutrients are not supplied, they will be drawn from the body of the dam. Consequently, the sow will farrow and begin her lactation period in a relatively weakened condition. Under these circumstances, the litter will be improperly nourished and a large percentage of weak, unthrifty pigs and a high mortality will result. It is also important to regulate feeding so that the sow will not be overly fat at farrowing time, for this condition also results in poorly developed pigs and difficult farrowing.

For short periods of time during the winter months, when pasture is not available, concentrates such as barley, milo, or corn, supplemented with skim milk or tankage, should make up the major part of the ration. Leafy alfalfa hay, fed in racks, scattered on feeding platforms, or chopped and mixed with the grain is the best substitute for alfalfa pasture. Alfalfa hay is bulky and should constitute not more than 10 to 12 per cent of the ration when mixed with grain. Roots and tubers are of value from the standpoint of succulence.

Housing presents more of a problem in the winter than in the summer. Too often sows about to farrow have inadequate shelter or are turned into barns or sheds with other livestock. This is poor practice. Clean, warm, well-bedded sleeping quarters with sufficient ventilation and plenty of room outside for exercise are desirable.

*Management at Farrowing Time.*—Careless, improper management at farrowing time may easily represent the difference between profit and loss. A sow raising four pigs requires as much care and nearly as much feed as one raising eight, thus making the initial cost of each pig in the former case almost double that in the latter. Losses due to a high death rate and to weak, unthrifty pigs may be largely overcome by proper feeding and management.

Placing the sow in the farrowing pen from four to seven days before she is expected to farrow will accustom her to the new surroundings and to the presence of the herdsman. Before being placed in the pen, she should be thoroughly washed with soap and water (fig. 9) and disinfected with a mild germicide. This may be accomplished by the use of a pressure spray or of a common sprinkling can.

Scrubbing the floor and walls of the farrowing pen with a scalding lye solution and thoroughly disinfecting it are highly recommended. Pens that are dry, airy, well-lighted, and free from drafts result in an increase in the number of pigs raised.



The bedding used should be clean and free from dust. Straw, cut hay (not too long), wood shavings, and rice hulls are satisfactory materials. Too much bedding is to be avoided, as the small pigs may become entangled and crushed by the mother. Enough bedding to insure cleanliness and warmth will give the best results. All bedding should be removed at least once a week and replaced with clean material. That which becomes soiled or wet should be removed daily.

Reducing the ration 30 to 50 per cent at this time will prove beneficial. The addition of 30 per cent of wheat bran to the ration during the week preceding farrowing tones up the system, prevents constipation, and makes for a normal parturition.



Fig. 9.—Washing the sow's udder before placing her in a clean farrowing pen.

The sow becomes restless as the time for farrowing approaches. She will be seen gathering bedding and making a nest for her litter. The vagina usually becomes swollen, and the milk is found in the udder twelve to twenty-four hours before farrowing. One light feed of bran mixed in the form of a thin slop, together with a supply of fresh, clean water, will be sufficient during the twenty-four hours preceding parturition.

Sows that have raised one or more litters successfully and have been handled properly during the gestation period will ordinarily have little difficulty in farrowing. Gilts giving birth to their first



litter will sometimes have trouble. These demand the closest attention. If continued labor seems of no avail, aid should be given as quickly as possible. The unskilled use of forceps is usually fatal to the pig and often results in injury to the generative organs of the sow. A well-greased hand and arm, clean and disinfected, are generally the best instruments. Pigs that are not presented properly should be forced back and turned in such a position as to make delivery possible. If the young gilt or mature sow is having extreme difficulty in delivering a pig or litter, the services of a competent veterinarian are desirable.

The value of watching the sows closely during the farrowing season cannot be over-emphasized. Inspection every two or three hours will save many pigs, as some in the new-born litters may wander away, become chilled, and be unable to obtain their first nourishment.

The mucus should be removed from the nose and mouth, and the body wiped dry as the pigs are born. As soon as they have gained a little strength, they should be allowed to suckle. Weak pigs and those unable to nurse may be induced to do so by stripping a little milk into the mouth; if they can be made to swallow, they will soon gain strength and be able to manage for themselves. If pigs become chilled, they may generally be revived in a warm box or in the direct rays of the sun, or by rubbing vigorously between the hands. If the sow is nervous or irritable during parturition, the pigs should be allowed to suckle and then be placed in a warm farrowing box (fig. 10) lined with straw and lightly covered to keep in the heat. During extremely cold weather, warm bricks or a jug of warm water placed in the box will add warmth. When farrowing is prolonged, it is considered good policy to return the pigs to the sow every one or two hours and allow them to suckle.

In case two or three small, rather weak pigs are farrowed in a litter of strong pigs, the stronger ones may be removed now and then to give the less vigorous ones a chance.

The afterbirth should be removed and buried or burned when it appears. If left in the pen, the sow will generally eat it. This, many think, encourages the pig-eating habit. A long-handled shovel or manure fork is useful for removing afterbirth from the farrowing pen.

The sow should be disturbed as little as possible while farrowing, no one except the attendant being allowed in the pen at this time. Quite often a pig will be farrowed apparently lifeless. In such cases, breathing may sometimes be started by removing the mucous covering over the mouth and nose and gently slapping along the side.

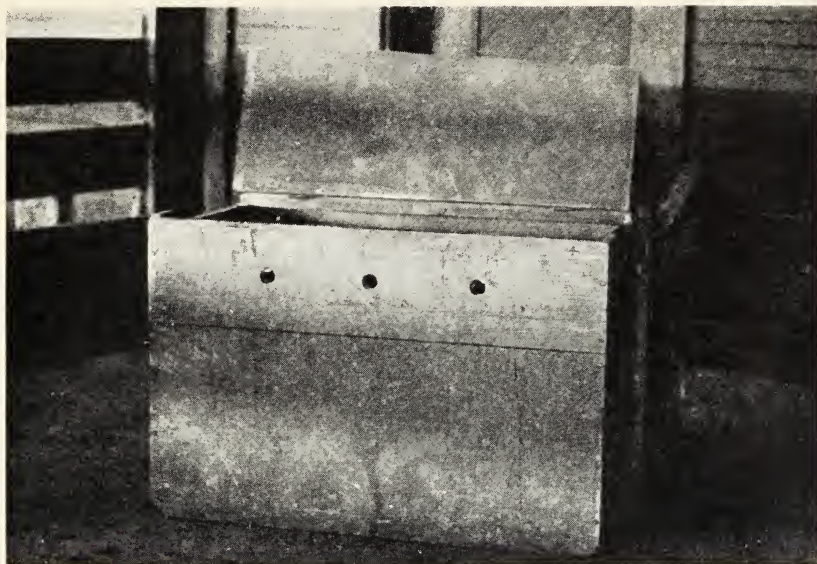


Fig. 10.—A practical type of farrowing box in use at the University of California. This box is 26 inches long, 18 inches wide, and 18 inches deep.



Fig. 11.—Removing needle-teeth from the suckling pig.

Occasionally a sow will farrow more pigs than she can properly nourish. Some of these pigs should be transferred to another sow that has recently farrowed a small litter. When sows do not provide milk at farrowing time, the milk flow may often be stimulated by applying hot packs to the udder and by vigorous massage.

About a day after farrowing, the eight needle-like teeth present in the upper and lower jaws of the young pigs should be removed by carefully cutting with wire snippers, as shown in figure 11. These teeth, which are also known as wolf or black teeth, are of no apparent value. If not removed, they are likely to prove a menace to the health and safety of the pigs, because biting each other while nursing often results in lacerated mouths that become infected. The pigs also bite the sow, causing her to jump suddenly, sometimes injuring or killing some of the litter.

The practice of marking the pigs in some way, with either an individual or litter number when they are a few days old is recommended. The most convenient and satisfactory method is the ear-notch system of identification.

*Pig-Eating Sows.*—Normal brood sows, fed properly during the gestation period, will not eat their pigs. It is commonly believed that the rations fed during the last two months of pregnancy, if deficient in protein and mineral matter, are contributing causes to this vice. The practice of feeding tankage or meat meal after farrowing may in some cases remedy the situation. Sows that have formed the pig-eating habit should be discarded for breeding purposes, fattened, and marketed.

*Feeding the Sow after Farrowing.*—Sows should receive no feed during the first twenty-four hours after farrowing and then only small amounts for the next three or four days. It is a good rule to feed one pound of a suitable concentrate mixture, such as rolled barley and wheat bran, equal parts by weight, on the second day, two pounds the third day, and increasing amounts daily until four or five pounds are being fed at the end of the first week. Under normal conditions, the sow can be on full feed in from ten to fourteen days after farrowing. The attendant should constantly watch for any digestive disturbances that become evident in the suckling pigs and should regulate the sow's feed accordingly. Over-feeding the sow, constipation, and lack of exercise may cause scours in pigs.

The feed requirements of the sow suckling a litter are much the same as those of the high-producing dairy cow. Nutrients are needed for the maintenance of the body and for the production of large



quantities of milk for the litter. A ration supplying liberal amounts of proteins and mineral matter, particularly calcium and phosphorus, will satisfy these demands. These materials may be supplied by home-grown grains, supplemented with such feeds as wheat middlings and tankage, which are rich in protein.

Proper feeding of the lactating sow is important. Over-feeding generally causes scours in pigs, while under-feeding often results in an excessive drain on the system of the sow.



Fig. 12.—Sow and litter 10 days of age, after having been moved from the farrowing house to clean pasture.

In from ten to fourteen days after farrowing, weather conditions permitting, the sows and pigs should be placed on clean pasture (fig. 12). Forage, preferably of the leguminous type, growing in recently plowed lots is a valuable addition to the ration because of its milk-producing properties, and also its liberal supply of proteins, minerals, and vitamins. Pasture also gives pigs ample opportunity for exercise in the sunlight.

When sows and their litters are being moved to the pasture, the pigs should be carried in a box, thus eliminating chances of picking up eggs of intestinal parasites.

Tightly fenced pastures, large enough to accommodate from two to four sows and their litters, are recommended. Adequate shelter should be provided; clean, warm, well-bedded houses are essential. If small pastures are not available, a greater number of sows and



litters may be placed on a large pasture, provided the pigs are of relatively uniform size. Too often sows with litters two or three weeks old are turned out with sows whose pigs are ready to wean. This usually results in a large number of small, unthrifty pigs. The best results will be obtained, however, by running a few sows together. More individual attention can be given in feeding the smaller pigs and they will have a better chance to grow and develop normally.

The feeding at this stage is important. Sows with normal-sized litters should be on full feed. Even so, heavy-milking sows will lose from 25 to 40 pounds during the lactation period. Sows that begin to take on flesh three or four weeks after farrowing should not be given all they will eat.

The number of pounds for a full feed varies with the individual and with the size and number of pigs in the litter. If a sow is fed slightly less than she will readily clean up twice a day, she may be considered on full feed. The appetite is a good guide in feeding.

At the United States Experiment Farm, Beltsville, Maryland, sows suckling their pigs were self-fed a ration consisting of shelled corn, wheat middlings, and a mineral mixture for a period of three years. The results were equal to and in some cases better than those obtained by hand-feeding. This method, however, is not the general practice in this state.

*Feeding the Suckling Pigs.*—When the pigs are from two to three weeks old, they will eat a little grain. A self-feeder placed in a small inclosure, known as a 'creep,' should be provided for the pigs. The common farm grains will meet the demands of the pigs at this age. As they grow older and their consumption of grain increases, they should have some protein supplement such as skim milk, middlings, tankage, or linseed-oil meal.

Skim milk fed with suitable concentrates is one of the best feeds known for young growing pigs, and should be given if available. It is advisable to feed small amounts at first, care being taken to increase the amount gradually, never to put out more than they will clean up.

*Weaning the Pigs.*—Where the system of farrowing two litters a year is practiced, as it is in most sections, pigs are weaned at from seven to nine weeks of age. At this time the pigs will be consuming considerable quantities of feed daily.

About a week before weaning, the sow should have her ration gradually reduced, thus causing a decrease in the flow of milk and indirectly helping to eliminate the possibility of caked or inflamed udders.

The best practice is to remove the sows from the pigs, leaving the latter on the same pasture which they have occupied during the suckling period.

If the sow's udder becomes hard or caked a day or so after weaning, place her with the pigs again and allow them to suckle. She should be removed when they have finished. This procedure should not be necessary more than once.

If the pigs are receiving skim milk at weaning time, it should be gradually increased, never allowing more than they will readily clean up in a short time.

The grain ration should not be changed at this time. However, if a change in feed is necessary, it should not be sudden, but extended over a period of from three to five days. Any sudden change in feed is likely to be harmful, and in some cases fatal, to pigs at any age.

*Feeding the Sow after Weaning.*—After weaning, the sow should be placed in a separate pasture and fed lightly until the secretion of milk ceases. The feed is then increased, the amount necessary depending upon the condition of the sow. Feeding heavily so that she will gain from one-half to one pound a day at breeding time is recommended.

#### THE YOUNG PIGS

*After Weaning.*—Soon after the pigs are weaned, the gilts and boars that are to be saved for breeding stock should be selected and separated from those to be fattened. A system of identification is valuable in making the selections. As a rule, only gilts and boars out of the best sows should be retained. When a large number of hogs are raised, this is difficult unless the practice of marking the litters or individual pigs is being followed.

The question of feeding and managing the pigs that are to be fattened for market is discussed on pages 34–40.

*Feeding the Orphan Pig.*—Evvard and Glatfelter,<sup>16</sup> of the Iowa station, recommend, after five years of experimentation, a ration of cow's whole milk, about one quart for each pig, plus a ration of mixed shelled corn or rolled barley and tankage, which can be self-fed. The addition of green alfalfa or alfalfa leaves is also helpful. For best results, the young pig should be fed five or six times daily for a time, this number gradually being cut to three.

<sup>16</sup> Evvard, John M., and G. B. Glatfelter. Saving the orphan pigs. Iowa Agr. Exp. Sta. Bul. 80:1–11. 1922.

*Gilts and Boars Retained for Breeding Purposes.*—The selection,<sup>1</sup> feeding, and care of the gilts retained for breeding purposes is important, because the future sow herd is dependent upon the gilts selected from each crop of pigs. Since it is desirable to obtain as much growth as possible, the gilts should be placed in a pasture. Hand feeding will, in most cases, prove the most successful, especially after a weight of about 100 pounds is reached. The ration should be of a type to promote growth rather than fat production. Liberal amounts of proteins and minerals should be provided.

Skim milk or buttermilk fed at the rate of three parts to one part of grain concentrates, by weight, is a satisfactory combination, with alfalfa pasture to promote proper growth and development in the young animal. The guide to be followed by the feeder is the production of thrifty growth rather than fat. The results obtained depend largely upon the common sense and judgment of the man doing the feeding.

The young boars saved for breeding purposes should be separated from the gilts soon after weaning. Their feeding and management are similar to those recommended for the developing gilt.

### FATTENING PIGS FOR MARKET

The most common methods of fattening pigs for market are: (a) full feeding on alfalfa or other forage; (b) feeding a limited ration on forage, (c) full feeding in dry lot; (d) hogging down crops; (e) using barley and rice stubble, orchard and vineyard wastes.

The two methods in most general use in the state are full feeding of grain on alfalfa pasture or other forage from weaning time until the desired market weight is attained, and feeding a restricted or medium grain ration with available forage or pasture and finishing in dry lot.

*Full Feeding on Forage.*—The first method is the quicker way to attain market weight; the feasibility and economy of this method, however, are dependent upon local conditions.

Thompson and Voorhies<sup>17</sup> have reported several experiments where various rations were fed on alfalfa pasture. Some of these data are presented in table 3.

Other data obtained by Hughes<sup>18</sup> at this station, where various rations were fed with alfalfa pasture, are presented in table 4.

<sup>17</sup> Thompson, J. I., and Edwin C. Voorhies. Hog feeding experiments. California Agr. Exp. Sta. Bul. 342:373-396. 1922.

<sup>18</sup> Hughes, E. H. The feeding value of raisins and dairy by-products for growing and fattening swine. California Agr. Exp. Sta. Bul. 440:1-12. 1927.

TABLE 3  
FULL FEEDING ON ALFALFA PASTURE

Ration	Average initial weight	Average daily gain	Feed consumed for 100 pounds of gain
	<i>pounds</i>	<i>pounds</i>	<i>pounds</i>
Rolled barley, self-fed.....	89.90	1.27	434 barley
Rolled barley and tankage, self-fed	89.73	1.34	421 barley 18 tankage
Rolled barley and cocoanut meal....	88.0	1.04	299 barley 111 coconut meal
Rolled barley and wheat middlings	103.3	1.27	360 barley 110 wheat middlings
Ground milo and tankage, self-fed....	102.8	1.54	400 ground milo 10 tankage

TABLE 4  
FULL FEEDING ON ALFALFA PASTURE

Ration	Average initial weight	Average daily gain	Feed consumed for 100 pounds of gain
	<i>pounds</i>	<i>pounds</i>	<i>pounds</i>
Rolled barley, 15 parts } Tankage, 1 part..... } By weight, mixed and self-fed.	82.95	1.66	361.11 barley 24.07 tankage
Rolled barley, 5 parts.. } Raisins, 5 parts..... } Rice bran, 5 parts..... } Tankage, 1 part..... } By weight, mixed and self-fed.	82.28	1.76	136.34 barley 136.34 raisins 136.34 rice bran 27.27 tankage
Raisins, 7½ parts..... } Rice bran, 7½ parts..... } Tankage, 1 part..... } By weight, mixed and self-fed.	81.39	1.48	220.31 raisins 220.31 rice bran 29.38 tankage

The results obtained from pigs fed barley and tankage and from those fed ground milo and tankage indicate relatively small consumption of tankage if good alfalfa is available.

The group fed rolled barley and tankage on pasture (fig. 13) did not gain so rapidly as those receiving barley, raisins, rice bran, and tankage; they did, however, produce gains on less feed than either of the other groups. This would be expected, because in a given



amount of barley there are more total digestible nutrients than in raisins or rice bran.

*Restricted Ration on Forage.*—In following the second plan, that of feeding a restricted grain ration on pasture, it is considered good practice to feed a concentrate ration of one or two pounds for each 100 pounds of live weight. Waste from vegetable gardens, vineyards, and orchards may be utilized under this scheme.

During the summer and fall of 1926, thirty-one pigs were fed on an acre of alfalfa pasture at this station. The pasture was divided into two half-acre lots, the pigs being pastured in one while the other was being irrigated. They were fed a limited ration of one part of rolled barley to three parts of skim milk by weight. It was planned that they should be fed such a quantity of barley and skim milk that they would consume a maximum quantity of alfalfa and yet gain at the rate of about one pound per head daily. The pigs fed from June until November gained 0.92 pounds per head daily and required 275 pounds of barley and 822 pounds of skim milk for 100 pounds of gain.

*In Dry Lot.*—Where only a limited amount of forage is available, pigs may be fattened in dry lot, placing them in the fattening pen soon after weaning, when they weigh from 45 to 75 pounds each. Pigs fattened in dry lot require more feeds rich in protein than those fattened on forage. Where pigs are fattened in this manner, occasional feeding of roots, tubers, pumpkins, or alfalfa hay adds nutrients, succulence, and variety to the ration.

Almost all of the demands of the young pig are for growth; therefore, rations rich in muscle and bone-building materials are necessary, in addition to the carbohydrates or energy-producing elements. Since the common farm-grown grains do not supply these materials in sufficient quantities for rapid growth, they must be supplemented with protein-rich feeds, such as the dairy by-products, tankage, fish meal, linseed-oil meal, and wheat middlings.

Protein-rich pasture for pigs during the growing period cannot be recommended too highly. It is an excellent and economical source of protein, mineral matter, particularly calcium, phosphorus, and iodine, and vitamins. Pigs on pasture seem more healthy and thrifty than those in small, cramped quarters. Pigs fed on legume pasture need less protein-rich supplements than those in dry lot. As they become older and heavier and the aim is one of fat production rather than growth, the amount of protein supplements in the ration may be gradually reduced, rations containing larger proportions of carbonaceous feeds being used.

It is not intended to present in this circular all the available information on dry-lot feeding, but rather to give the average results of experimentation with the more common rations used. Pigs being fattened in dry lot should have plenty of shade and clean water and a suitable mineral mixture. Their quarters should be kept clean.

Table 5 is a summary of trials of pigs fattened in dry lot.

The rapid gains made by the fattening pigs and the reduction of the amount of feed necessary for 100 pounds of gain show clearly the advantages of adding a protein supplement to barley and to corn.



Fig. 13.—Fattening pigs fed a ration of rolled barley and tankage self-fed in separate feeders, and alfalfa pasture.

Excellent and economical gains were made by pigs fed barley and tankage or barley and skim milk. A ration of ground milo and skim milk produced about the same results as rolled barley and skim milk.

The average results indicate that the feeding of such rations as barley and tankage or barley and skim milk produces about the same results as rations of corn and tankage or corn and skim milk.

*Hogging Down Crops.*—Experiments conducted in the Corn Belt states have demonstrated that hogs do as well and often better when allowed to harvest their own corn than when it is hauled to them in the feed lot. Experience has proved that allowing the pigs a supplement, either in the form of some nitrogenous concentrate such as tankage or fish meal or in the form of some legume forage such as alfalfa pasture, produces more rapid and economical gains than when no supplement is provided.

TABLE 5  
FATTENING PIGS IN DRY LOT

Ration	Average initial weight	Average daily gain	Feed consumed for 100 pounds of gain
	<i>pounds</i>	<i>pounds</i>	<i>pounds</i>
Rolled barley, self-fed..... (Average of 3 trials)	73.93	0.73	546.44 barley
Rolled barley..... Tankage.....	86.27	1.54	420.00 barley 41.73 tankage
Self-fed. (Average of 5 trials.)			
Rolled barley..... Alfalfa hay (in racks).....	87.50	0.93	465.00 barley 38.00 alfalfa hay
Rolled barley..... Raisins..... Rice bran..... Tankage, self-fed in separate feeder	56.75	1.07	161.033 barley 161.033 raisins 161.033 rice bran 30.67 tankage
Equal parts, mixed and self-fed.			
Rolled barley..... Raisins..... Tankage.....	65.25	1.24	252.17 barley 166.37 raisins 75.31 tankage*
Self-fed. (Average of 2 trials.)			
Rolled barley, 1 part..... Skim milk, 3 parts.....	54.33	1.61	280.48 barley 841.45 skim milk
By weight.			
Rolled barley, 1 part..... Whey, 1 part.....	53.53	1.40	331.40 barley 994.19 whey
By weight.			
Rolled barley, 1 part..... Raisins, 1 part..... Skim milk, 6 parts.....	54.53	1.47	156.08 barley 156.08 raisins 936.46 skim milk
By weight.			
Rolled barley, 1 part..... Raisins, 1 part..... Whey, 6 parts.....	54.07	1.04	195.24 barley 195.24 raisins 1171.42 whey
By weight.			
Ground milo..... Skim milk.....	73.10	1.55	289.00 milo 896.00 skim milk
Ground milo..... Whey.....	72.80	1.32	349.00 milo 1346.00 whey
Rolled barley..... Rice polish..... Tankage.....	109.70	1.88	269.86 barley 121.14 rice polish 25.39 tankage
Self-fed in separate feeders. (Average of 2 trials.)			

\* In one trial a 45-per-cent-protein tankage was fed, which partially accounts for the amount of tankage consumed.

TABLE 5—(Continued)

Ration	Average initial weight	Average daily gain	Feed consumed for 100 pounds of gain
Rolled barley..... } Equal parts, self-fed. Rice polish..... } Tankage, self-fed in separate feeder	<i>pounds</i> 57.00	<i>pounds</i> 1.41	<i>pounds</i> 183.14 barley 183.14 rice polish 33.27 tankage
Rolled barley.... } Self-fed in separate feeders. Rice bran..... } (Average of 2 trials.) Tankage..... }	97.76	1.81	323.35 barley 89.72 rice bran 25.21 tankage
Rolled barley..... } Equal parts, self-fed. Rice bran..... } Tankage, self-fed in separate feeder	56.10	1.30	202.095 barley 202.095 rice bran 53.60 tankage
Rough rice, finely ground } Self-fed in separate feeders. Tankage..... } (Average of two trials)	80.45	1.39	461.07 rice 55.84 tankage
Corn alone†.....	136.70	1.12	545.90 corn
Corn†..... Tankage.....	138.70	1.74	380.20 corn 40.20 tankage
Corn†..... Skim milk.....	108.38	1.66	302.07 corn 799.40 skim milk

†Average of several experiments reported in: Smith, W. W. *Pork Production*, pp. 241 and 256. The Macmillan Co., New York. 1920.

NOTE.—All the information presented in this table is found in California Agr. Exp. Sta. Buls. 342, 420, and 440, except that concerning corn.

While there is no experimental evidence concerning the hogging-down of barley, it is practiced in some localities. Producers have found that relatively small areas should be hogged down at one time, that it is necessary to have water close at hand, and that where natural shade is lacking temporary shade must be supplied.

*Hogs on Stubble Fields.*—The gleaning of barley, wheat, and rice-stubble fields is an important factor in economical pork production in this state. Two systems of management are practiced. The more common is to turn sows and pigs into the stubble fields and keep them there until they are fat or until the fields have been cleaned. Water and shade are provided, but no effort is made to provide additional protein, either in the form of pasture or commercial supplement. Some producers, however, are allowing either sows, or sows with pigs,



the run of barley or rice-stubble and, in addition, are providing alfalfa pasture and in some cases, when pasture is not to be had, are supplying tankage in a self-feeder. Pigs over 75 pounds in weight do better on stubble than lighter pigs. A clean, dry bed should be provided in the rice-stubble fields.

### MARKETING

The most desirable market weight from the standpoint of both the producer and the consumer is from 175 to 200 pounds.

Hogs are sold to local butchers, shipped directly to the packers, marketed through cooperative farm-bureau associations, or consigned to commission firms to be sold at union stock yards. The cooperative farm-bureau hog-auction association of the lower San Joaquin Valley has been a very successful one.

It is good business to produce the kind of hogs the public demands and to sell them to the highest bidder, whether he be the local butcher or some other agency.

### SANITATION AND CONTROL OF PARASITES

Clean premises and clean, well-lighted, ventilated barns and sheds are good insurance against various types of infection. Plowing the lots close to the barn once or twice a year and seeding them to some annual crop such as barley and rape, keeping the manure away from the barns and lots, scattering air-slacked lime in the pens and on the feeding floors occasionally, and keeping the troughs and feeding utensils clean, all are factors in keeping down infection and in providing wholesome surroundings for the growing pigs.

*Control of the Round Worm.*—The McLean County System has produced some excellent results in preventing round-worm infestation. Before the farrowing season begins, the farrowing house and particularly the walls, partitions, and floor of the farrowing pens are thoroughly washed and scrubbed with scalding water and lye. The pen is then thoroughly disinfected with any standard disinfectant, and fresh, clean straw is put in.

Before the sows that are due to farrow are put into the pens, they are washed thoroughly, particularly the udder and underline, as a protection against carrying round-worm eggs into the clean pen. The sow is kept in the pen until she has farrowed and her pigs are strong enough to be removed from the barn to a clean, non-infested pasture.



marked without injury soon after birth, thus reducing the possibility of mistaken identity. The producer of purebreds should be thoroughly conversant with breed association rules. Blank forms and information may be secured from the secretary of the breed association. A simple system of bookkeeping is of value in placing any business on a sound basis.

Information on the breeding operations is important in the grade herd. A record of the breeding date, the boar used, the farrowing date, the number of pigs farrowed and raised, is valuable, and a system of litter identification is essential. Here again, the ear-notch method is in common use. It is important to know the number of pigs raised by each sow, so that one proving unproductive may be recognized and placed in the fattening pen. The litter identification also affords an opportunity to select breeding stock of known parentage.

Metal tags bearing a number are sometimes inserted in the ear as a means of identification. These are placed close to the head to prevent tearing out. Even with this precaution, however, they are often lost. A tag placed in each ear will, in a measure, overcome this difficulty, and if one tag is lost it should be replaced immediately by another. As tags are not satisfactory for small pigs, some other means of identification must be employed until the pigs are large enough for the tags to be inserted. The tag system of marking is not recommended because it is difficult to read the numbers and the tags are too often lost.

The system of ear notching is the most common method of marking little pigs or mature hogs. Pigs a day or two old may be marked, the notches being retained throughout life. Each notch should be large enough to facilitate ease in reading, yet not too large to disfigure the ear. The system shown in figure 16 is in use at the California station.

The position of the notch or notches in the ear determines the number of the pig. A notch placed in the lower side of the left ear, close to the head, is No. 1; in the lower side, midway between the tip and the head, is No. 2; in the lower side, close to the tip, is No. 3; and so on up to No. 5.

By placing two notches in the ear and adding together the figures for which they stand, the numbers 6, 7, 8, and 9 can be obtained. For instance, if a notch were placed in the upper side of the left ear, close to the tip, and one in the lower side, midway between the tip and the head, the number would total 4 plus 2, or 6. To make the number 7, notches in the positions of 5 and 2 should be used, as 4 and 3 both occupy positions at the tip of the ear, and ears so notched tear easily.



Fig. 15.—An effective means of identification: ear notching the suckling pig.

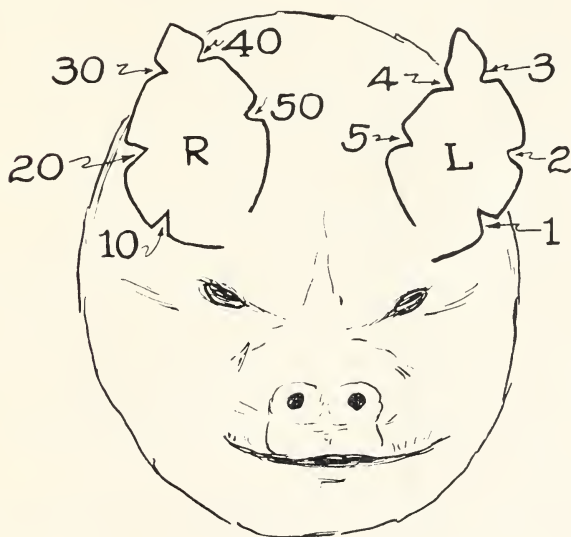


Fig. 16.—One method of ear notching.



The corresponding five notches on the right ear, starting on the lower side and going around, represent 10, 20, 30, 40, and 50 respectively. By placing two notches in the right ear and adding together the figures they represent, the numbers 60, 70, 80, and 90 are obtained.

Suppose, for example, a pig is to be numbered 98. This would be done by placing a notch in the upper side, near the tip (40) and a notch in the upper side, midway between the tip and the head (50), in the right ear; a notch in the upper side of the left ear, midway between the tip and the head (5), and in the lower side, close to the tip (3), would total (50 plus 40) 90, on the right ear, and (5 plus 3) 8, on the left ear.

In grade herds, each pig in a litter may be given the same number; in purebred herds each pig should have an individual number.

*Castration.*—Castration of small pigs can be performed with efficiency and without much danger if proper precautions are taken.

The best time to castrate is from six to eight weeks of age, while the pigs are still suckling. It is a good plan to give no feed except the mother's milk the day before and the day after castration. The operation performed at this age does not materially retard growth, as the shock to the pig is almost negligible. Moreover, a pig of this size is small enough to be handled easily, making the operation simple. If the pigs are castrated with clean, disinfected hands, and knife, and if the incisions are made large enough to insure good drainage, there is less danger from infection. The sows and pigs should be placed in clean pastures or in clean lots after castration so that the possibility of infection will be reduced to a minimum.

*Ringling.*—Rooting is a habit practiced by most hogs. The most common method of prevention is to place a small ring in the cartilage at the end of the snout. This can be accomplished by one man holding the small pig and another man inserting the ring with the ringer. Older and larger hogs can be snubbed to a post by the use of a small rope attached to the upper jaw, the ring being inserted as in the case of smaller pigs. Rings and a ringer can be purchased at most hardware stores. The practice of cutting the snout to prevent rooting is not a good one.

*Gestation Table.*—Table 6 is figured on a gestation period of 114 days, figuring in the breeding and farrowing dates. The gestation period of sows varies somewhat, 114 days being an average. To be safe, it is always good practice to put the sow in the farrowing pen a few days before she is due to farrow.

TABLE 6  
GESTATION TABLE

Breeding date	Farrowing date	Breeding date	Farrowing date	Breeding date	Farrowing date
Jan. 1	Apr. 24	May 6	Aug. 27	Sept. 8	Dec. 30
Jan. 6	Apr. 29	May 11	Sept. 1	Sept. 13	Jan. 4
Jan. 11	May 4	May 16	Sept. 6	Sept. 18	Jan. 9
Jan. 16	May 9	May 21	Sept. 11	Sept. 23	Jan. 14
Jan. 21	May 14	May 26	Sept. 16	Sept. 28	Jan. 19
Jan. 26	May 19	May 31	Sept. 21	Oct. 3	Jan. 24
Jan. 31	May 24	June 5	Sept. 26	Oct. 8	Jan. 29
Feb. 5	May 29	June 10	Oct. 1	Oct. 13	Feb. 3
Feb. 10	June 3	June 15	Oct. 6	Oct. 18	Feb. 8
Feb. 15	June 8	June 20	Oct. 11	Oct. 23	Feb. 13
Feb. 20	June 13	June 25	Oct. 16	Oct. 28	Feb. 18
Feb. 25	June 18	June 30	Oct. 21	Nov. 2	Feb. 23
Mar. 2	June 23	July 5	Oct. 26	Nov. 7	Feb. 28
Mar. 7	June 28	July 10	Oct. 31	Nov. 12	Mar. 5
Mar. 12	July 3	July 15	Nov. 5	Nov. 17	Mar. 10
Mar. 17	July 8	July 20	Nov. 10	Nov. 22	Mar. 15
Mar. 22	July 13	July 25	Nov. 15	Nov. 27	Mar. 20
Mar. 27	July 18	July 30	Nov. 20	Dec. 2	Mar. 25
Apr. 1	July 23	Aug. 4	Nov. 25	Dec. 7	Mar. 30
Apr. 6	July 28	Aug. 9	Nov. 30	Dec. 12	Apr. 4
Apr. 11	Aug. 2	Aug. 14	Dec. 5	Dec. 17	Apr. 9
Apr. 16	Aug. 7	Aug. 19	Dec. 10	Dec. 22	Apr. 14
Apr. 21	Aug. 12	Aug. 24	Dec. 15	Dec. 27	Apr. 19
Apr. 26	Aug. 17	Aug. 29	Dec. 20	.....	.....
May 1	Aug. 22	Sept. 3	Dec. 25	.....	.....



# PUBLICATIONS AVAILABLE FOR FREE DISTRIBUTION

## BULLETINS

- |  |   |
|--|---|
| <p>No.</p> <p>253. Irrigation and Soil Conditions in the Sierra Nevada Foothills, California.</p> <p>262. Citrus Diseases of Florida and Cuba Compared with those of California.</p> <p>263. Size Grades for Ripe Olives.</p> <p>268. Growing and Grafting Olive Seedlings.</p> <p>273. Preliminary Report on Kearney Vineyard Experimental Drain, Fresno County, California.</p> <p>276. The Pomegranate.</p> <p>277. Sudan Grass.</p> <p>278. Grain Sorghums.</p> <p>279. Irrigation of Rice in California.</p> <p>283. The Olive Insects of California.</p> <p>294. Bean Culture in California.</p> <p>304. A Study of the Effects of Freezes on Citrus in California.</p> <p>310. Plum Pollination.</p> <p>312. Mariout Barley.</p> <p>313. Pruning Young Deciduous Fruit Trees.</p> <p>319. Caprifigs and Caprification.</p> <p>324. Storage of Perishable Fruit at Freezing Temperatures.</p> <p>325. Rice Irrigation Measurements and Experiments in Sacramento Valley, 1914-1919.</p> <p>328. Prune Growing in California.</p> <p>331. Phylloxera-Resistant Stocks.</p> <p>335. Coconut Meal as a Feed for Dairy Cows and Other Livestock.</p> <p>339. The Relative Cost of Making Logs from Small and Large Timber.</p> <p>340. Control of the Pocket Gopher in California.</p> <p>343. Cheese Pests and Their Control.</p> <p>344. Cold Storage as an Aid to the Marketing of Plums.</p> <p>346. Almond Pollination.</p> <p>347. The Control of Red Spiders in Deciduous Orchards.</p> <p>348. Pruning Young Olive Trees.</p> <p>349. A Study of Sidedraft and Tractor Hitches.</p> <p>350. Agriculture in Cut-over Redwood Lands.</p> <p>353. Bovine Infectious Abortion.</p> <p>354. Results of Rice Experiments in 1922.</p> <p>357. A Self-mixing Dusting Machine for Applying Dry Insecticides and Fungicides.</p> <p>358. Black Measles, Water Berries, and Related Vine Troubles.</p> <p>361. Preliminary Yield Tables for Second Growth Redwood.</p> <p>362. Dust and the Tractor Engine.</p> <p>363. The Pruning of Citrus Trees in California.</p> <p>364. Fungicidal Dusts for the Control of Bunt.</p> <p>365. Avocado Culture in California.</p> <p>366. Turkish Tobacco Culture, Curing and Marketing.</p> <p>367. Methods of Harvesting and Irrigation in Relation of Mouldy Walnuts.</p> <p>368. Bacterial Decomposition of Olives during Pickling.</p> <p>369. Comparison of Woods for Butter Boxes.</p> <p>370. Browning of Yellow Newtown Apples.</p> <p>371. The Relative Cost of Yarding Small and Large Timber.</p> <p>373. Pear Pollination.</p> <p>374. A Survey of Orchard Practices in the Citrus Industry of Southern California.</p> <p>375. Results of Rice Experiments at Cortena, 1923.</p> <p>376. Sun-Drying and Dehydration of Walnuts.</p> <p>377. The Cold Storage of Pears.</p> <p>379. Walnut Culture in California.</p> | <p>No.</p> <p>380. Growth of Eucalyptus in California Plantations.</p> <p>382. Pumping for Drainage in the San Joaquin Valley, California.</p> <p>385. Pollination of the Sweet Cherry.</p> <p>386. Pruning Bearing Deciduous Fruit Trees.</p> <p>387. Fig Smut.</p> <p>388. The Principles and Practice of Sun-drying Fruit.</p> <p>389. Berseem or Egyptian Clover.</p> <p>390. Harvesting and Packing Grapes in California.</p> <p>391. Machines for Coating Seed Wheat with Copper Carbonate Dust.</p> <p>392. Fruit Juice Concentrates.</p> <p>393. Crop Sequences at Davis.</p> <p>394. Cereal Hay Production in California. Feeding Trials with Cereal Hay.</p> <p>395. Bark Diseases of Citrus Trees.</p> <p>396. The Mat Bean (<i>Phaseolus aconitifolius</i>).</p> <p>397. Manufacture of Roquefort Type Cheese from Goat's Milk.</p> <p>398. Orchard Heating in California.</p> <p>399. The Blackberry Mite, the Cause of Redberry Disease of the Himalaya Blackberry, and its Control.</p> <p>400. The Utilization of Surplus Plums.</p> <p>401. Cost of Work Horses on California Farms.</p> <p>402. The Codling Moth in Walnuts.</p> <p>404. The Dehydration of Prunes.</p> <p>405. Citrus Culture in Central California.</p> <p>406. Stationary Spray Plants in California.</p> <p>407. Yield, Stand and Volume Tables for White Fir in the California Pine Region.</p> <p>408. Alternaria Rot of Lemons.</p> <p>409. The Digestibility of Certain Fruit By-products as Determined for Ruminants.</p> <p>410. Factors Affecting the Quality of Fresh Asparagus after it is Harvested.</p> <p>411. Paradichlorobenzene as a Soil Fumigant.</p> <p>412. A Study of the Relative Values of Certain Root Crops and Salmon Oil as Sources of Vitamin A for Poultry.</p> <p>414. Planting and Thinning Distances for Deciduous Fruit Trees.</p> <p>415. The Tractor on California Farms.</p> <p>416. Culture of the Oriental Persimmon in California.</p> <p>417. Poultry Feeding: Principles and Practice.</p> <p>418. A Study of Various Rations for Finishing Range Calves as Baby Beeves.</p> <p>419. Economic Aspects of the Cantaloupe Industry.</p> <p>420. Rice and Rice By-products as Feeds for Fattening Swine.</p> <p>421. Beef Cattle Feeding Trials, 1921-24.</p> <p>422. Cost of Producing Almonds in California; a Progress Report.</p> <p>423. Apricots (Series on California Crops and Prices).</p> <p>424. The Relation of Rate of Maturity to Egg Production.</p> <p>425. Apple Growing in California.</p> <p>426. Apple Pollination Studies in California.</p> <p>427. The Value of Orange Pulp for Milk Production.</p> <p>428. The Relation of Maturity of California Plums to Shipping and Dessert Quality.</p> <p>429. Economic Status of the Grape Industry.</p> |
|--|---|



## CIRCULARS

No.

87. Alfalfa.
117. The Selection and Cost of a Small Pumping Plant.
127. House Fumigation.
129. The Control of Citrus Insects.
136. *Melilotus indica* as a Green-Manure Crop for California.
144. Oldium or Powdery Mildew of the Vine.
157. Control of the Pear Scab.
164. Small Fruit Culture in California.
166. The County Farm Bureau.
170. Fertilizing California Soils for the 1918 Crop.
173. The Construction of the Wood-Hoop Silo.
178. The Packing of Apples in California.
179. Factors of Importance in Producing Milk of Low Bacterial Count.
202. County Organizations for Rural Fire Control.
203. Peat as a Manure Substitute.
209. The Function of the Farm Bureau.
212. Salvaging Rain-Damaged Prunes.
215. Feeding Dairy Cows in California.
217. Methods for Marketing Vegetables in California.
230. Testing Milk, Cream, and Skim Milk for Butterfat.
231. The Home Vineyard.
232. Harvesting and Handling California Cherries for Eastern Shipment.
234. Winter Injury to Young Walnut Trees during 1921-22.
238. The Apricot in California.
239. Harvesting and Handling Apricots and Plums for Eastern Shipment.
240. Harvesting and Handling Pears for Eastern Shipment.
241. Harvesting and Handling Peaches for Eastern Shipment.
243. Marmalade Juice and Jelly Juice from Citrus Fruits.
244. Central Wire Bracing for Fruit Trees.
245. Vine Pruning Systems.
248. Some Common Errors in Vine Pruning and Their Remedies.
249. Replacing Missing Vines.
250. Measurement of Irrigation Water on the Farm.
252. Supports for Vines.
253. Vineyard Plans.
254. The Use of Artificial Light to Increase Winter Egg Production.
255. Leguminous Plants as Organic Fertilizer in California Agriculture.
256. The Control of Wild Morning Glory.
257. The Small-Seeded Horse Bean.
258. Thinning Deciduous Fruits

No.

259. Pear By-products.
261. Sewing Grain Sacks.
262. Cabbage Growing in California.
263. Tomato Production in California.
264. Preliminary Essentials to Bovine Tuberculosis Control.
265. Plant Disease and Pest Control.
266. Analyzing the Citrus Orchard by Means of Simple Tree Records.
267. The Tendency of Tractors to Rise in Front; Causes and Remedies.
269. An Orchard Brush Burner.
270. A Farm Septic Tank.
272. California Farm Tenancy and Methods of Leasing.
273. Saving the Gophered Citrus Tree.
276. Home Canning.
277. Head, Cane, and Cordon Pruning of Vines.
278. Olive Pickling in Mediterranean Countries.
279. The Preparation and Refining of Olive Oil in Southern Europe.
281. The Results of a Survey to Determine the Cost of Producing Beef in California.
282. Prevention of Insect Attack on Stored Grain.
283. Fertilizing Citrus Trees in California.
284. The Almond in California.
285. Sweet Potato Production in California.
286. Milk Houses for California Dairies.
287. Potato Production in California.
288. Phylloxera Resistant Vineyards.
289. Oak Fungus in Orchard Trees.
290. The Tangier Pea.
291. Blackhead and Other Causes of Loss of Turkeys in California.
292. Alkali Soils.
293. The Basis of Grape Standardization.
294. Propagation of Deciduous Fruits.
295. The Growing and Handling of Head Lettuce in California.
296. Control of the California Ground Squirrel.
298. The Possibilities and Limitations of Coöperative Marketing.
300. Coccidiosis of Chickens.
301. Buckeye Poisoning of the Honey Bee.
302. The Sugar Beet in California.
303. A Promising Remedy for Black Measles of the Vine.
304. Drainage on the Farm.
305. Liming the Soil.
306. A General Purpose Soil Auger and its Use on the Farm.
307. American Foulbrood and its Control.
308. Cantaloupe Production in California.
309. Fruit Tree and Orchard Judging.

The publications listed above may be had by addressing

**College of Agriculture,  
University of California,  
Berkeley, California.**